

Final Report : Dept. Pesticide Regulations Pest Management Grant 1996

Principal Investigator:

Dr. Dan Gonzaléz
Dept. of Entomology
University CA Riverside

Marcella Waggoner
Dept. of Entomology
University CA Riverside

Project Title: "Establishment of Effective Natural Enemies of Vine Mealybug -- A Basis for a Stable Grape IPM Program"

Summary:

Several biotypes of *Anagyrus pseudococchi* (Timberlake) were mass released in the Coachella Valley from March through September. Work has been concentrated at four farms and more than 400,000 total parasites have been released to date. Successful release from quarantine of two additional species *Coccidoxenoides peregrinus* (Timberlake) and *Leptomastidea abnormis* (Girault) has been achieved. Colonies of both of these additional parasites are established in the insectary facility where they are being readied for mass production and release. Limited field releases of *L. abnormis* and *C. peregrinus* were made during the month of September and October, and from February to the present. Total numbers of all *Anagyrus* colonies being mass released in 1996 are presented in Table 1.

Evaluation of the success of these parasites under field conditions is also underway. We have been able to recover parasites from a variety of field conditions.

Trials for ant control have been initiated

Results and Discussion:

**OBJECTIVE 1: ESTABLISH AN IPM INNOVATOR PROGRAM USING
GUIDELINES PROVIDED BY THE DEPT. PESTICIDE REGULATION**

(a) Communications and outreach efforts have been focused in 2 categories: 1) exchange of information and research ideas with research collaborators, growers and regulatory agencies, and 2) presentations of research results at grower and UC extension supported meetings. Details are provided below:

1) Exchange of information:

- In order to obtain information about mealybug problems on various farms, to discuss our present results or to review ideas for further cooperative efforts, contacts were made with managers of farms where we are carrying out our research trials. L. González at Sun World, and E. Walker and L. Flores at Peter Rabbit Farms have all been valuable resources and willing cooperators.
- We have maintained close contact with research collaborators including: J. Ball and C. Godfrey -CDFA and E. Reeves - Riverside Agricultural Commissioners Office.
- We have fostered cooperative relations with UC Extension personnel especially R. Neja - Riverside Co. Farm Advisor and W. Bentley - UCIPM Grapes, State-wide Extension Coordinator as well as other UC farm advisors from the central Valley. These contacts have been invaluable to us for helping to initiate additional grower contacts and for coordinating formal outreach efforts.

2) Presentation of research results:

- California Desert Grape Research Committee. Thermal, California- November, 1995. We presented a research proposal, requested and obtained commitment to assist in formation of Grape IPM Innovator Program for Coachella Valley.
- Mealybug Research Meeting sponsored by California Table Grape Commission and UC Cooperative Extension, Bakersfield, California- July, 1996. We discussed mealybug research progress, long and short term strategies and also future needs and coordination of efforts.
- UC Cooperative Extension, Coachella Valley Grape Growers. Coachella, California- October, 1996. We are scheduled to make a research presentation similar to that given in Bakersfield. We will also request commitments for planning the formation of Grape IPM Innovator Program for the Coachella Valley.
- Planning meeting for formation of Grape IPM Innovator Program for Coachella Valley. Planning in collaboration with California Desert Grape Research Committee,

UC Cooperative Extension Service, and Riverside County Agricultural
Commissioner. Meeting is planned for April 1997.

GRAPE IPM INNOVATOR PROGRAM COOPERATORS :

Louis González and Vic Salazar
Sun World, Inc.
Ave. 73 and Filmore
Oasis, Ca 92274
(619) 397-0120 - Office
(619) 775-3266

Pam Larson

Bob Melkesian
R.B.M. Enterprises
49-111 Hwy 111 Unit 3
Coachella, CA 92236
(619) 774-3214

Omar Ortega
Oscar J. Ortega Farm
Ave. 58
Coachella, CA 92236
(619) 398-6458

Mike Rucker
Gold Coast Farms
Ave. 58
Thermal, CA
(619) 399-1158

Victor Teram
Western Farm Service
53-800 Polk St.
Coachella, CA 92236
(619) 398-4613

Eddie Walker and Louis Flores
Peter Rabbit Farms
85810 Grapefruit Blvd.
Coachella, CA
(619) 398-0157
(619) 398-0972

Mike Weeks
K&W Farms
73-386 Bursera Way
Palm Desert, CA
(619) 393-0098

OBJECTIVE 2:

To screen and evaluate the impact of native biological control agents.

- (a) over a period of 2 years in collaboration with J. Ball and K. Godfrey of CDFA, very few and ineffective numbers have been found of a naturally occurring (studies in fields far from new parasite releases) *Anagyrus pseudococci*.

OBJECTIVE 3:

To import, rear, and release beneficial insects in selected sites and determine the status of colonization success.

- (a) Releases of parasites imported from Turkmenistan, Israel, and Spain were reared and released in 4 vineyards from March through November in 1996 (Table 1) and from January through the present in 1997. Numbers released in 1997 are as follows:

<i>Leptomastidea abnormis</i> :	3,600
<i>Coccidoxenoides peregrinus</i> :	1,015
<i>Anagyrus pseudococci</i> :	<u>16,400</u>
1997 TOTAL TO DATE	21,015

(b) Efforts to determine colonization success were as follows:

- (i) Field cages have been placed on mealybug infested vines at weekly intervals from November to June. Within these cages, releases of small numbers of mated female *Anagyrus* were made. The cages were left on for one week at which time the loose bark harboring mealybug infestations was carefully peeled back and mealybugs were returned to the lab for possible emergence of parasites. In 52 cage tests, only 3 parasite recoveries were made. One was substantial with 94 parasites recovered. Because of concerns about the destruction of the mealybugs during recovery procedures and the subsequent low survival rate, we have decided to discontinue this technique as a sampling method.

(ii) As an alternative to the above method, we began taking samples of vine stems and grape clusters from mealybug infested fields where mass release efforts were ongoing. In these tests, infestations of mealybugs were caged and parasites released within the cages. Cages were left for one week and then cuttings of the infested vine stems and grape clusters were made. These samples were returned to the laboratory for rearing of parasites. Successful recovery of parasites has been made under these conditions (Table 2a). We are anticipating a larger scale experiment of this type, where the vines are actually cut up and returned to the lab for a more thorough examination. From this more extensive test, we hope to learn more about host and parasite habitat utilization throughout the growing season.

(iii) Field cage releases were made weekly on mealybug infested potato sprouts. Releases were made in 2 vineyards at opposite extremes of the Coachella Valley. Several different numbers of females in different tests have been used in cages. The optimal minimum number to release for comparative evaluation trials appears to be 3 ♀ and 2 ♂ per cage. Laboratory reared potatoes infested with mealybug were placed in the field within the vine canopy. Small fabric field cages enclosed the potato and secured it to the vine support system. Small numbers of mated female *Anagyrus* were released within each cage to determine which colonies, of those currently in culture, would be able to survive and reproduce under the harsh conditions in the Coachella Valley. So far, recoveries have been made from all *Anagyrus* colonies (Figure 1). We are analyzing these results in order to help reduce the colonies being held to ones that show the most promising results. In addition to recoveries of *Anagyrus*, we have also recovered substantial numbers of *Leptomastidea abnormis* and *Coccidoxenoides peregrinus* released in October. The latter 2 species were delayed in quarantine because of APHIS restrictions.

Although final results are still being tabulated as trials are still in progress, several results are very obvious: (1) all *Anagyrus* colonies and *L. abnormis* and *C. peregrinus* survive and reproduce on vine mealybugs in the extreme summer heat of the Coachella Valley (Fig. 1); (2) under comparative conditions, the population originally from Coachella Valley was consistently the least effective in parasitizing, surviving and reproducing on vine mealybugs (Fig. 1); (3) under comparative conditions 2 populations of *Anagyrus* (San Martin and Givat Ada) stand out as most effective against vine mealybug under extremely hot conditions, from 7 replicates over a 2 month period. The 5 *Anagyrus* populations (San Martin, Givat Ada, Kfar, Tabor and Arugot, 2 crops) producing the greatest impact against vine mealybug are being further evaluated in similar trials from November through March to assess their potential for overwintering and for reproducing on vine mealybugs under cold conditions where mealybugs are most scarce.) Assessment of these releases will be made by placing vine mealybugs on trap hosts in release versus non-release areas from four fields. A minimum of 10 replicates will be taken from each treatment every 2 weeks. Data will be analyzed via analyses of variance.

(iv) Uncaged mealybug infested potatoes have been placed in the field within the vine canopy in areas where mass releases of beneficial insects has been ongoing.

These were left for one week and then returned to the lab for emergence of parasites. Parasites are being recovered from some of these "traps" which may indicate success of the mass releases effort (Tables 2a,2b, 2c). To date, from preliminary trials, recoveries of parasites have been made in potatoes placed out in previous release areas as well as potatoes positioned several rows away from the mass release area (Table 2d). Since this method proved to be a viable sampling method, further evaluation of *Anagyrus* parasites on uncaged "trap" plants of potted potato tubers are now underway. We are expanding this effort to include two separate locations where ongoing releases were made. "Trap" pots will be placed near release sites and also in positions 30 to 60 rows away from where mass releases were conducted on a weekly basis for six weeks. With this effort, we hope to be able to determine continued success of our release effort and also monitor the extent to which the parasites can move from the initial release area into adjacent areas of the field.

(v) Evaluation releases of *Anagyrus* parasites on caged grape clusters were also conducted and additional trials are being initiated with store- bought grapes that are infested in the lab and set in field cages for evaluation of parasite activity.

(vi) An additional field cage trial was conducted at the Agricultural Operations in Riverside in order to assess different cage fabrics on parasite releases. Large field cages (3'X 3' X 6') were placed over 5 gallon potted vines of flame grapes that had been infested with mealybugs. Results of this trial are pending but initial observations show improved recovery of parasites in caged vs. non-caged plants. In addition, a test was conducted to assess the ability of each of the 9 colonies to attack mealybugs on grapes. Bouquets of grape leaves from mealybug infested vines were set into plastic cages in an environmentally controlled temperature cabinet (80° F). Small numbers of mated female *Anagyrus* were added. Recoveries have been made from all colonies.

OBJECTIVE 4:

To obtain information on ant species that tend mealybug population^S and to test controls to eliminate or reduce ant numbers without disturbing natural enemy populations.

- (a) Two principal ant species have been observed tending mealybugs aggressively: (1) *Formica* spp. and (2) *Solenopsis xyloni*, fire ants.

(b) We have set up experimental trials on 2 farms in which we are treating $\frac{1}{2}$ of our parasite release area with Tahara, and leaving the other half untreated for ants. We will continue to assess impact from released (open-field) and caged parasite trials in both of these treatments. Tahara is being used on the recommendation of H. Shorey, as the best material available for ant control in vineyards. We will continue to sample ant species throughout the season and make visual observations on ant behavior in treated verses untreated plots.

Table 1. Open-field Releases of Parasites of *Planococcus ficus* (Signoret) the Vine Mealybug in Coachella Valley, 1996 Field Season -Mid June to Mid September. Parasites Reared at UCR Insectary Facility

Parasite species	Colony Origin	From	Numbers released
<i>Anagyrus pseudococci</i>	Arugot, Israel	Grapes	43,320
<i>Anagyrus pseudococci</i>	Kfar Tabor, Israel	Figs	27,920
<i>Anagyrus pseudococci</i>	Turkmenistan	Grapes & Figs	8,640
<i>Anagyrus pseudococci</i>	Algeciras & San Martin, Spain	Citrus	18,410
* <i>Leptomastidea abnormis</i>	Jordan Valley, Israel	Citrus & Pomegranate	21,010
<i>Anagyrus pseudococci</i>	Ysrael Valley-Insectary colony	Citrus	2,000
<i>Anagyrus pseudococci</i>	Kibbutz Yaatir, Israel	Grapes	8,430
<i>Anagyrus pseudococci</i>	San Juan, Spain	Grapes	14,515
<i>Anagyrus pseudococci</i>	Arugot & Sharow, Israel	Persimmon	31,930
<i>Anagyrus pseudococci</i>	Givat Ada, Israel	Grapes	9,255
<i>Anagyrus pseudococci</i>	Kibbutz Givat, Israel	Citrus & Pomegranate	14,650
<i>Anagyrus pseudococci</i>	Coachella Valley	Grapes	1,395
* <i>Coccixenoides peregrinus</i>	Israel	Citrus & Pomegranate	2,800
			Total = 204,275 (mid June -Nov.16,1996)
			Total = 247,905 (March to mid June)
			Grand total =452,180

* Released from quarantine July, 1996

Table 2a

Total # of Parasites Recovered from Various Caged Field Experiments

Parasite	LOCATION	CROP	Potatoes 6/28/96 Parasites **	Potatoes 7/7/96 Parasites	Potatoes 7/13/96 Parasites	Potatoes 8/2/96 Parasites	Potatoes 8/8/96 Parasites	Potatoes 8/23/96 Parasites	Vine Stems & Grape Clusters 8/8/96		Vine Cuttings: Lab Exp. 6/24/96 Parasites
<i>Anagyrus pseudococc</i>	Arugot, Israel	Grapes	123	34	168	84	201	4	0	25	
<i>Anagyrus pseudococc</i>	Kfar Tabor, Israel	Figs	55	24	162	18	158	77	0	4	
<i>Anagyrus pseudococc</i>	Turkmenistan	Grapes & Figs	80	25	37	3	14	7	0	12	
<i>Anagyrus pseudococc</i>	Algeiras & San Marlin, Spain	Citrus	293	2	177	213	182	412	0	22	
<i>Leptomastix a abnormis</i> *	Jordan Valley, Israel	Citrus & Pomegranat ^e					11	11	0		
<i>Anagyrus pseudococc</i>	Kibbutz Yaalir, Israel	Grapes	84	87	31	84	29	2	7	5	
<i>Anagyrus pseudococc</i>	San Juan, Spain	Grapes	628	33	2	167	99	7	1	16	
<i>Anagyrus pseudococc</i>	Arugot & Sharow, Israel	Persimmon	423	31	36	16	11	194	0	24	
<i>Anagyrus pseudococc</i>	Givat Ada, Israel	Grapes	183	11	167	142	13	152	12	15	
<i>Anagyrus pseudococc</i>	Kibbutz Givat, Israel	Citrus & Pomegranat ^e	26	0	125	45	12	214	66	14	
<i>Anagyrus pseudococc</i>	Coachella, Riverside Co.	Grapes				72	18	4	0		

* Released from quarantine in July 1996.

**Emerged

N.B.: Experiments run 6/28 though 8/8 used 10 female parasites and experiments run after 8/16 used 5 female parasites per cage.

Tables 2b & 2c Total # of Parasites Recovered from Various uncaged Field Experiments

Table 2b

			UnCaged Potatoes: Field Exp. 8/8/96
Colony	SOURCE	CROP	Total Parasites
<i>Anagyrus pseudococci</i>	Arugot, Israel	Grapes	21
<i>Anagyrus pseudococci</i>	Kfar Tabor, Israel	Figs	9
<i>Anagyrus pseudococci</i>	Turkmenistan	Grapes & Figs	0
<i>Anagyrus pseudococci</i>	Algeciras & San Martin, Spain	Citrus	
<i>Leptomastidea abnormis</i> *	Jordan Valley, Israel	Citrus & Pomegranate	0
<i>Anagyrus pseudococci</i>	Kibbutz Yaatir, Israel	Grapes	36
<i>Anagyrus pseudococci</i>	San Juan, Spain	Grapes	0
<i>Anagyrus pseudococci</i>	Arugot & Sharow, Israel	Persimmon	0
<i>Anagyrus pseudococci</i>	Givat Ada, Israel	Grapes	
<i>Anagyrus pseudococci</i>	Kibbutz Givat, Israel	Citrus & Pomegranate	
<i>Anagyrus pseudococci</i>	Coachella, Riverside Co.	Grapes	1

* Released from quarantine in July 1996

Table 2c

	UnCaged Potatoes: Field Exp. 8/16/96
REPLICATES	Total Parasites
1	54
2	13
3	20
4	22
5	12
6	23

N.B.: Table 2b indicates experiments where parasites were released at the base of the potatoes or grapes; table 2c indicates experiments where no parasites were released near potatoes or grapes.

Table 2D

**TOTAL PARASITES RECOVERED FROM OPEN POTATO TRIALS
(2 REPETITIONS)**

SUNWORLD 1A			
AREA	FEMALES	MALES	TOTAL PARASITES
RELEASE	100	44	144
NON-RELEASE	0	0	0

Figure 1. Mean # of Females Recovered From 7 Trials

